Waiting on Oil Markets: Houston’s Economy Seeks Direction

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Current Slowdown in Houston Has Been a Complicated Story

• Oil has been at the heart of Houston’s recent problems, and this has been a brutal downturn for the drilling industry
• Unlike most recent downturns in drilling, this has not been accompanied by a U.S. or global recession. The U.S. economy continues to work for Houston
• A decade of rapid growth left tremendous forward momentum in place as the fracking bust started
• The collapse in natural gas prices kicked off $50 billion in construction along the Ship Channel in east Houston
• The question about the local business cycle has always been how these plusses and negatives add up
Current Slowdown Marked the End of a Decade of Job Growth

Note: December to December changes, except 2016 which is year-to-date, annualized, and seasonally adjusted. TWC estimates.
Slow But Still Positive: Houston Nets 26,700 Jobs in Last 21 Months

(3-month percent change at annual rates)

Texas Workforce Commission and Bureau of Labor Statistics
Official Figures Point to Houston Job Growth That Is Slow or Slightly Negative

<table>
<thead>
<tr>
<th>Year</th>
<th>Jobs</th>
<th>Change*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>118,600</td>
<td>4.3%</td>
</tr>
<tr>
<td>2013</td>
<td>89,800</td>
<td>3.2%</td>
</tr>
<tr>
<td>2014</td>
<td>117,800</td>
<td>4.0%</td>
</tr>
<tr>
<td>2015</td>
<td>14,500</td>
<td>0.5%</td>
</tr>
<tr>
<td>2016</td>
<td>5,600</td>
<td>0.2%</td>
</tr>
<tr>
<td>... through Sept</td>
<td>5,600</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Texas Workforce Commission estimates at seasonally adjusted annual rates
## Job Losses Are Driven By Energy
(Net Change in Jobs, seas. adj.)

<table>
<thead>
<tr>
<th>Sector</th>
<th>In 2015 Dec ‘14 – Dec ‘15</th>
<th>So far in 2016 Dec 15 - Sep 16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New Jobs</td>
<td>Percent</td>
</tr>
<tr>
<td>Total Payroll</td>
<td>14,400</td>
<td>0.5%</td>
</tr>
<tr>
<td>Mining</td>
<td>-17,600</td>
<td>-17.3%</td>
</tr>
<tr>
<td>Construction</td>
<td>12,100</td>
<td>5.6%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-23,900</td>
<td>-9.6%</td>
</tr>
<tr>
<td>Machinery</td>
<td>-11,600</td>
<td>-19.6%</td>
</tr>
<tr>
<td>Fab Metal</td>
<td>-10,600</td>
<td>-17.5%</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>-1,200</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Prof/Buss Services</td>
<td>-6,700</td>
<td>-1.4%</td>
</tr>
</tbody>
</table>

*2016 TWC estimates at seasonally adjusted annual percentage rates*
Growth of Selected Services Remains Strong

Percent 3-month change at annual rates, seas. Adj.

New Jobs Added Since Oil Crisis Begins in Dec 2014

- 29,100 food service
- 25,500 health care
- 18,000 retail trade
- 10,500 public education
- 3,500 entertainment
- 2,000 finance
- 1,400 accommodation

Texas Workforce Commission
Where Did This Service Sector Growth Come From?

- Where did this services growth come from?
  - Strong national markets: United Airlines, Sysco, AIG, HP
  - Petrochemical construction boom in East Houston
  - Past momentum, built on Houston’s 680,000 new jobs from 2004-2014
  - In-migrations continues strongly for several quarters after job growth slows
  - Most direct damage is confined to oil producers, oil services, and manufacturing ... so far

- BUT ... we are now 23 months into this slowdown. The chemical boom is over, momentum has waned, population growth is evaporating. Only the U.S. economy left to help out ... until oil turns up.
All That Said and Done … The Jobs Numbers Are Subject to Revision (Change in Payroll Jobs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Period</th>
<th>TWC Official Number</th>
<th>Dallas Fed Revised</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Dec - Dec</td>
<td>20,700</td>
<td>6,000</td>
</tr>
<tr>
<td>2016</td>
<td>Dec - Sep</td>
<td>5,600</td>
<td>-800</td>
</tr>
</tbody>
</table>

Dallas Fed Sees TWC estimates 20,000 too high

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[Graph showing revisions from Dec-14 to Aug-16 with preliminary and unrevised estimates.]
Notable Sectors Where TWC Job Estimates Were High or Low By June

- Total Over-Estimate = 19,700
- Sectors Over-Estimated
  - Manufacturing = 10,400
  - Leisure and Hospitality = 7,100
  - Wholesale Trade = 6,500
  - Education and Health = 2,200
  - Retail = 2,000
- Sectors Under-Estimated
  - Professional and Business Services = 5,300
  - Transportation = 1,800
  - Information = 1,800
  - Construction and Mining = 1,400

Note: TWC estimate minus Dallas Fed preliminary re-benchmark
Plenty of Other Signs of a Big Slowdown or Mild Reversal

Houston unemployment rate moves above U.S. to 5.4%

Quarterly Sales and Use Tax Collections Down 8% for City & METRO MTA

Bureau of Labor Statistics

Texas Comptroller, seasonally adjusted
Purchasing Managers’ Index
U.S. and Houston Compared (s.a.)

Index > 50 means expansion
Index < 50 contraction

National Association of Purchasing Management - Houston
Recession? Ask the Dallas Fed
Business Cycle Index

Tracks local business cycle with four variables

Now on brink of recession, if not in it

2000 to 2016

2013 - 2016
What Drove the Big Upturn in the Third Quarter? (Change in Payroll Jobs)

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Dallas Fed Sees TWC estimates 20,000 too high

Graph: Preliminary Revisions vs. Unrevised
Oil Markets and Oil Price
Over the Long-Term the World’s Demand for Oil Has Grown Steadily (million bbl./d)

- Asian Financial Crisis/Tech Bust
- Great Recession
- Commodity Boom
- Fracking Bust
Drilling Recovery Means Oil Near $65/bbl.

Long-Run Marginal Cost of Global Oil Production

This chart is stylized and illustrative.
Global Crude Surplus Was Never Large, Gap Now Closing?

Supply Minus Global Demand (million b/d)

Growth of Demand Holds While Supply Shrinks (4-Q Percent Change)

As Oil Prices Rose This Spring, Mild Optimism Returned to the Oil Market

- The big three oil service companies all declared a bottom was in place for drilling in Q2/Q3 earnings reports
- Oil service and machinery stocks quickly rose 30% in February and March as oil prices moved off $30/bbl., and are up 10% since then
- The rig count has steadily added back over 150 rigs from the March low
- But ahead: “a long, slow grind ahead,” “no V-shaped recovery in sight,” and “land recovering, but not yet international and offshore”
Definitive Turn in Drilling?  
Or Just a Dead Cat Bounce?  
Drilling Has Turned Up from Historic Lows

Weekly Count of Working Rigs

488 Rig Count was previous all-time low

2008-2009

2014-2016

Weeks after peak in drilling activity
Building Scenarios for Recovery in Oil

• When will oil prices hit bottom?
• When will the rig count turn up?
• When do energy jobs begin to come back?
• How high will the rig count go in this recovery?
• How long before the rig count reaches these highs?
Recovery in Rig Count After Oil Prices Definitively Move Up
(working rigs by quarter after oil prices begin to rise, s.a.)

Baker Hughes, calculations of IRF
# Drilling Recovery After the Price of Oil Hits a Low

## Past Recoveries

<table>
<thead>
<tr>
<th>Quarters Until:</th>
<th>1982-87</th>
<th>1997-98</th>
<th>2001-03</th>
<th>2008-09</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig Count Begins Definitive Turn Up</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Energy Jobs Make a Low</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>High Rig Count</td>
<td>never</td>
<td>8</td>
<td>8</td>
<td>11</td>
<td>10</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

## Forecast

<table>
<thead>
<tr>
<th>Quarters Until:</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig Count Begins Definitive Turn Up</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Energy Jobs Make a Low</td>
<td>4</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>High Rig Count</td>
<td>10</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

Note: For the high, medium and low forecasts, it is assumed that the rig count returns to 1650, 1500, and 1300, respectively. Given the complexity of modern and future rigs, think of this as future activity based on “current equivalent” rigs.
Other Key Assumptions for Houston Recovery

• **Rig Count Accelerates?**
  • High Scenario: 2016 Q4
  • Medium Scenario: 2017 Q1/Q2
  • Low Scenario: 2017 Q3/Q4

• **Rig Count Max After Recovery?**
  • High Scenario: 1650
  • Medium Scenario: 1500
  • Low Scenario: 1300

• **Return of Energy Jobs**
  • Follow the rig count
  • Allow for complexity of fracking, productivity trends
  • Never returns to previous highs in any scenario

Note: Rig count accelerates refers to point where “long slow grind” ends and normal pace of recovery in drilling sets in.
Rig Count Scenarios and the Return of Oil Employment in Houston

Rig Count

Oil-Related Jobs in Houston (000)
U.S. Economy Continues to Grow Strongly and Create Jobs

• Assume in all scenarios that the U.S. economy has put the Great Recession behind it

• Consumer has deleveraged; state and local governments are collecting revenues at a healthy rate and spending; the housing market has returned to close to normal

• U.S. job growth is at 1.7 percent or about 200,000 jobs per month throughout the forecast horizon

• We see the export sector, especially manufacturing struggling with the strong dollar, but domestic growth is robust
$164 Billion U.S. Construction Boom is Based on Cheap Energy

- This $164 billion total includes many industries and all of the U.S.
- New ethylene crackers, more ethylene-related expansion in PE, PVC and other derivative plants
- LNG export terminals to sell surplus natural gas into global markets
- Refiners have joined in with additional expansions

Note: The $164 billion figure is based on all U.S. shale-related expansion, estimated by the American Chemistry Council in April, 2016
Natural gas prices collapsed in late 2011 ($/mcf)

DOE/EIA
Natural Gas Energy Content Equivalent to $15 - $30 per Barrel for Oil

DOE/EIA and calculations of the author
Large Projects Headline Over $50 Billion in East Houston Construction

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Project</th>
<th>Completion</th>
<th>Value ($ mil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exxon</td>
<td>Baytown</td>
<td>Ethylene</td>
<td>2017</td>
<td>$5,000</td>
</tr>
<tr>
<td>Chevron</td>
<td>Freeport</td>
<td>Ethylene</td>
<td>2017</td>
<td>$4,000</td>
</tr>
<tr>
<td>Dow</td>
<td>Baytown</td>
<td>Ethylene</td>
<td>2017</td>
<td>$3,500</td>
</tr>
<tr>
<td>BASF</td>
<td>Freeport</td>
<td>Ethylene</td>
<td>2017</td>
<td>$3,000</td>
</tr>
<tr>
<td>Freeport LNG</td>
<td>Freeport</td>
<td>LNG Export</td>
<td>2019</td>
<td>$3,000</td>
</tr>
<tr>
<td>Freeport LNG</td>
<td>Freeport</td>
<td>LNG Export</td>
<td>2020</td>
<td>$3,000</td>
</tr>
<tr>
<td>Bayer</td>
<td>Baytown</td>
<td>PUR Facility</td>
<td>2021</td>
<td>$2,000</td>
</tr>
<tr>
<td>CPV</td>
<td>Freeport</td>
<td>Gas to Polypropylene</td>
<td>2017</td>
<td>$1,500</td>
</tr>
<tr>
<td>Freeport LNG</td>
<td>Freeport</td>
<td>Methane to Propylene</td>
<td>2018</td>
<td>$1,400</td>
</tr>
</tbody>
</table>
Projects Begin to Wind Down Rapidly After 2017
(Value of Projects Completed, $ million)
Put It All Together

• Three oil scenarios: high, medium, or low. High sees solid recovery now underway in drilling; medium sees strength delayed until early 2017; low until late 2017

• Continued U.S. expansion at moderate rates

• The end of most of the petrochemical construction on the East Side. Some new construction, but nothing to replace the boom-time construction that finishes

• Data revisions that point to possible mild local recession in early 2016.
## Forecast Job Growth in Houston
### 2013-2020
(000 New Jobs, Q4/Q4)

<table>
<thead>
<tr>
<th>Year</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>30/60/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>90.3</td>
<td>90.3</td>
<td>90.3</td>
<td>90.3</td>
</tr>
<tr>
<td>2014</td>
<td>112.3</td>
<td>112.3</td>
<td>112.3</td>
<td>112.3</td>
</tr>
<tr>
<td>2015</td>
<td>117.1</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
</tr>
<tr>
<td>2016</td>
<td>-18.2</td>
<td>-23.0</td>
<td>-27.1</td>
<td>-22.0</td>
</tr>
<tr>
<td>2017</td>
<td>27.0</td>
<td>-2.8</td>
<td>-19.2</td>
<td>4.5</td>
</tr>
<tr>
<td>2018</td>
<td>95.7</td>
<td>71.2</td>
<td>33.8</td>
<td>74.8</td>
</tr>
<tr>
<td>2019</td>
<td>91.3</td>
<td>87.3</td>
<td>53.4</td>
<td>85.1</td>
</tr>
<tr>
<td>2020</td>
<td>87.1</td>
<td>81.7</td>
<td>69.9</td>
<td>81.1</td>
</tr>
</tbody>
</table>

Calculations of IRF, based on drilling scenarios above
## Compared to What We Were Saying Before?

**Flip Forecast 2017 Recession Into 2016**

(Thousands of Jobs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Current 30/60/10</th>
<th>May 2016 30/50/20</th>
<th>November 2015 40/40/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>112.3</td>
<td>112.1</td>
<td>103.6</td>
</tr>
<tr>
<td>2015</td>
<td>17.1</td>
<td>23.4</td>
<td>14.0</td>
</tr>
<tr>
<td>2016</td>
<td>-22.0</td>
<td>-10.8</td>
<td>20.1</td>
</tr>
<tr>
<td>2017</td>
<td>4.5</td>
<td>-30.0</td>
<td>74.4</td>
</tr>
<tr>
<td>2018</td>
<td>74.8</td>
<td>62.9</td>
<td>86.8</td>
</tr>
<tr>
<td>2019</td>
<td>85.1</td>
<td>97.1</td>
<td>73.6</td>
</tr>
</tbody>
</table>

Calculations of Institute for Regional Forecasting
In-Migration Follows Job Growth: Forecast In-Migration for Houston

• When population grows, in-migration gives biggest economic stimulus
• As job growth rises, in-migration begins to rise a year later
• In recovery, in-migration falls a year behind
• Data at right matches 30/60/10 weighted employment forecast, sees a 2018 bottom for in-migration
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